Defect Review in the Photonics Revolution

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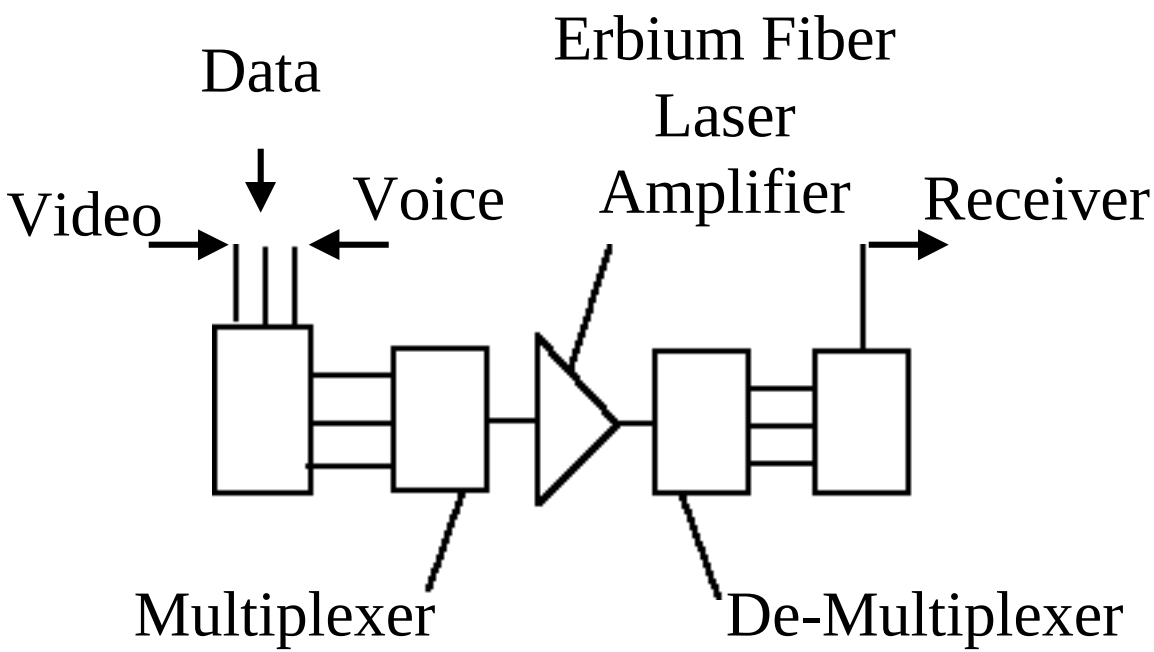
Components of The DWDM Revolution



A New Direction for WDM Test & Measurement

- The Need - Decreasing Size and Increasing Integration
- The Technology - Near-field Optics

3. The level of Optical Resolution - 0.05 microns
4. New Correlations -

Light distribution

with simultaneous nanometer information on

Topography

Polarization

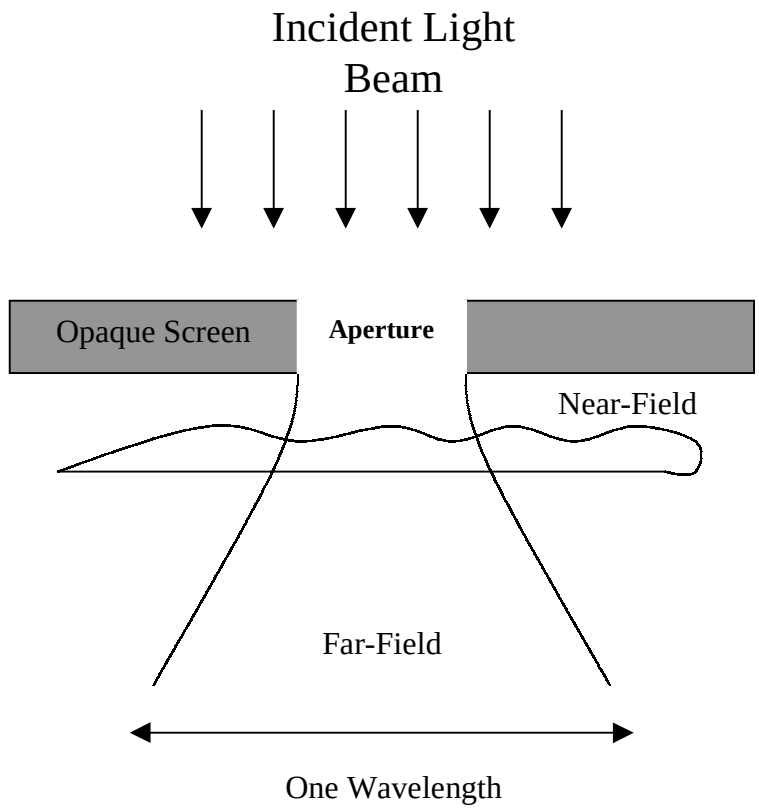
Electrical Characterization

Thermal Characterization

What is Near-Field Optics?

1. Collection or illumination of light through a sub-wavelength aperture

2. Scanning of sample or aperture relative to one another in the near-field

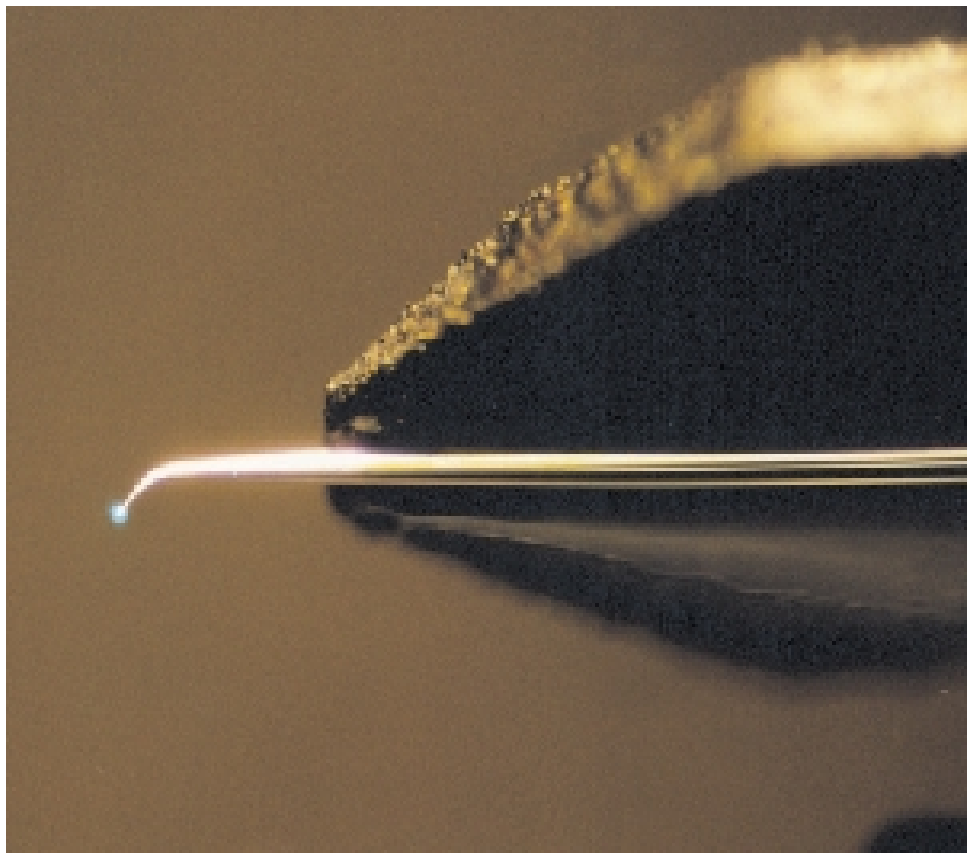


Near-field Optical Element

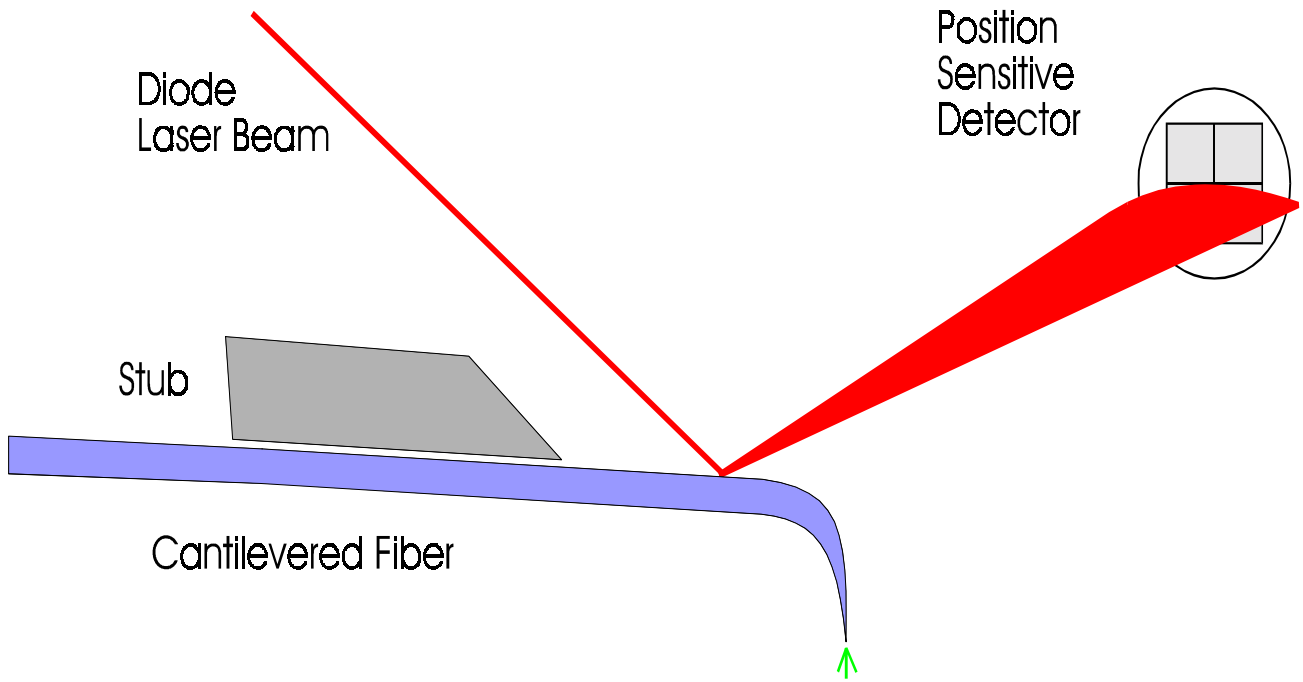
1. Tapered cantilevered metal-coated optical fiber probe

2. Simultaneous optical and topographical imaging

3. Simultaneous electrical [resistance, capacitance etc.] imaging



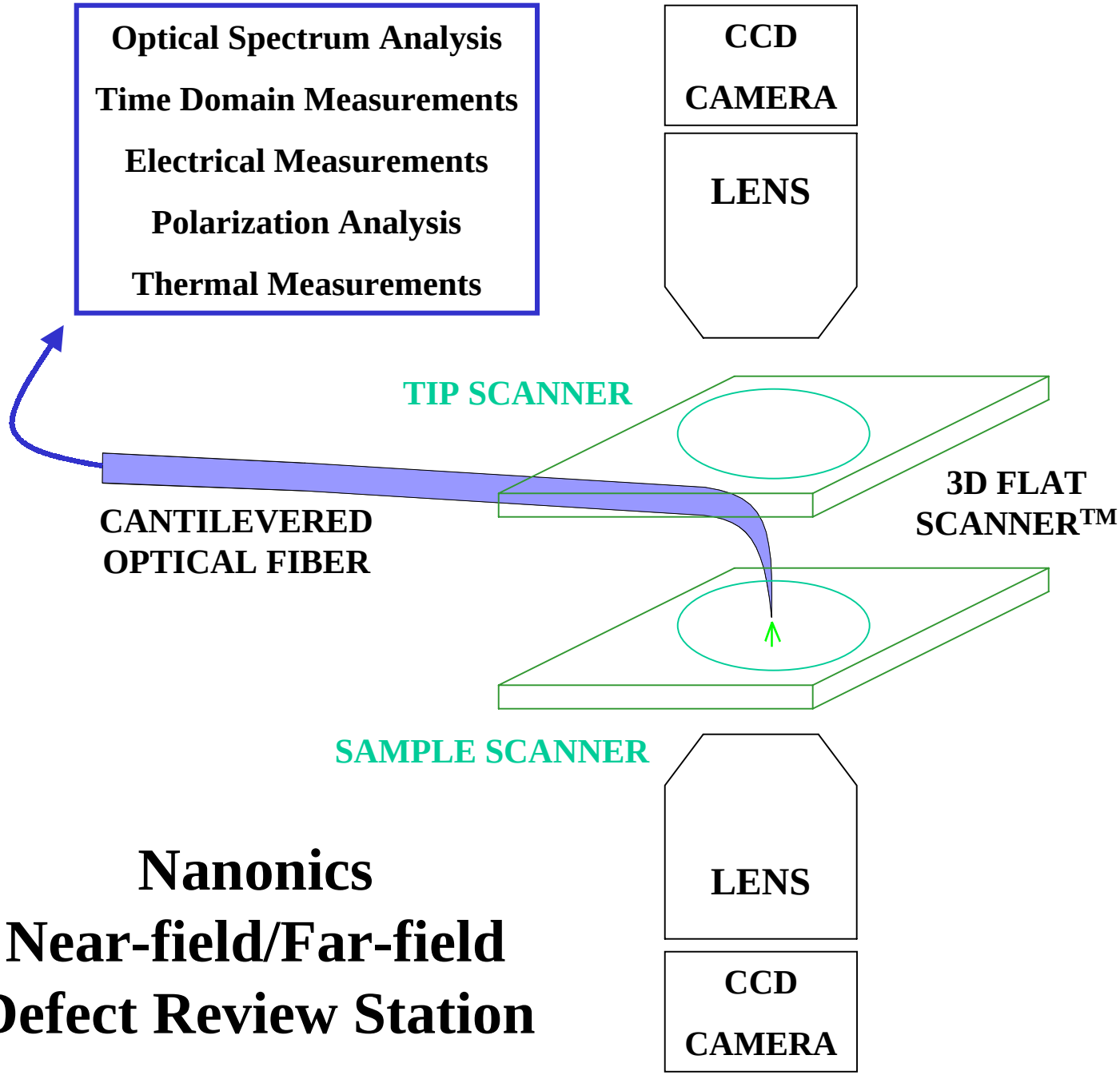
Deflection Force Sensing



The standard optical method

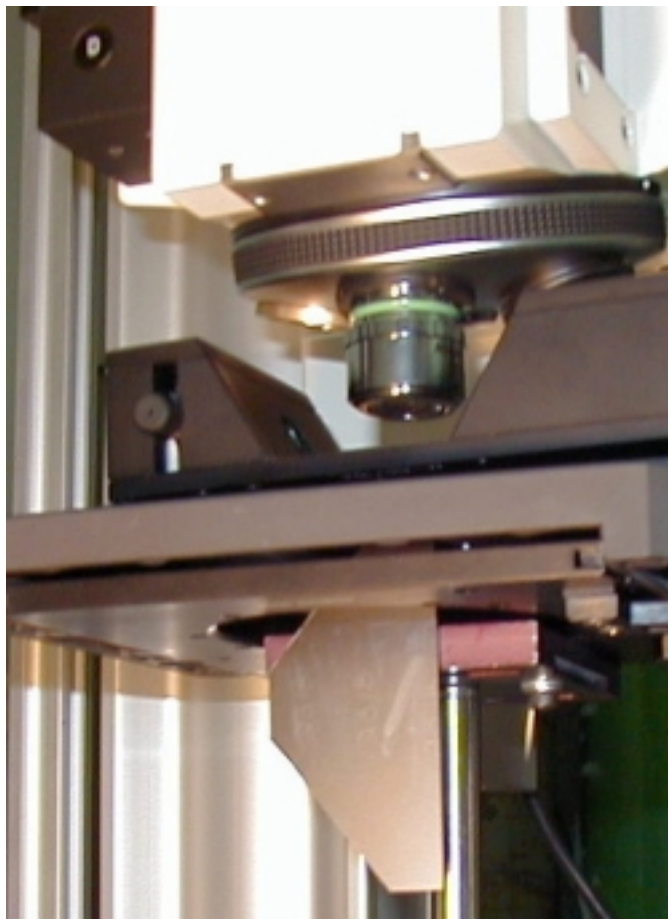
1. Cantilevered optical fibers are excellent atomic force sensors that can operate to detect surface topography either in contact or by being close but not in physical contact with the surface

2. Nanonics also provides non-optical means of deflection sensing

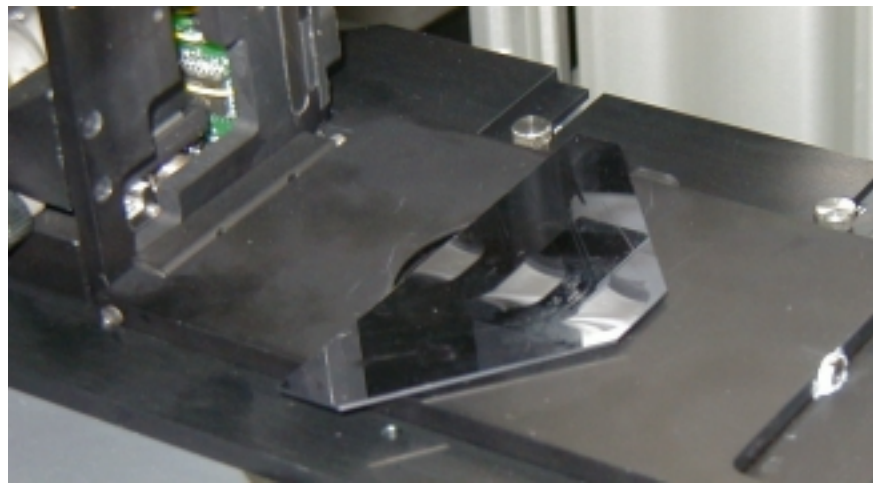


Nanonics
Near-field/Far-field
Defect Review Station

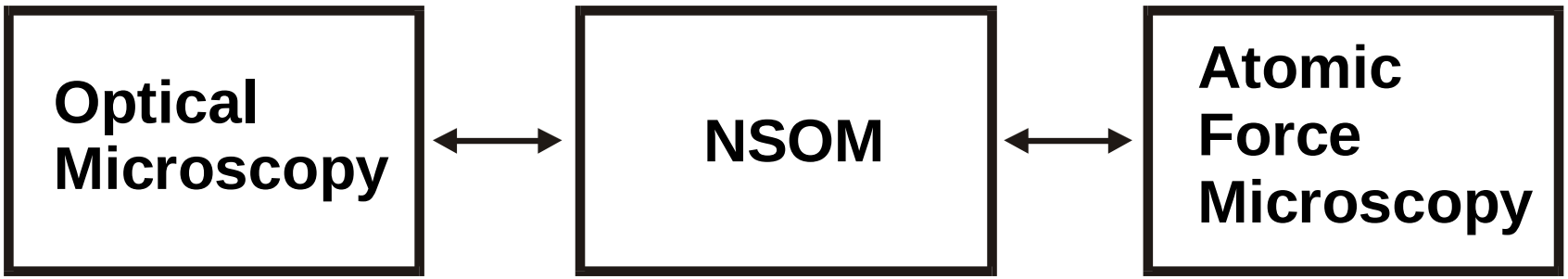
System Flexibility



Placement of waveguide for high resolution injection of light at the edge of the guide



Placement of the waveguide for imaging evanescent fields



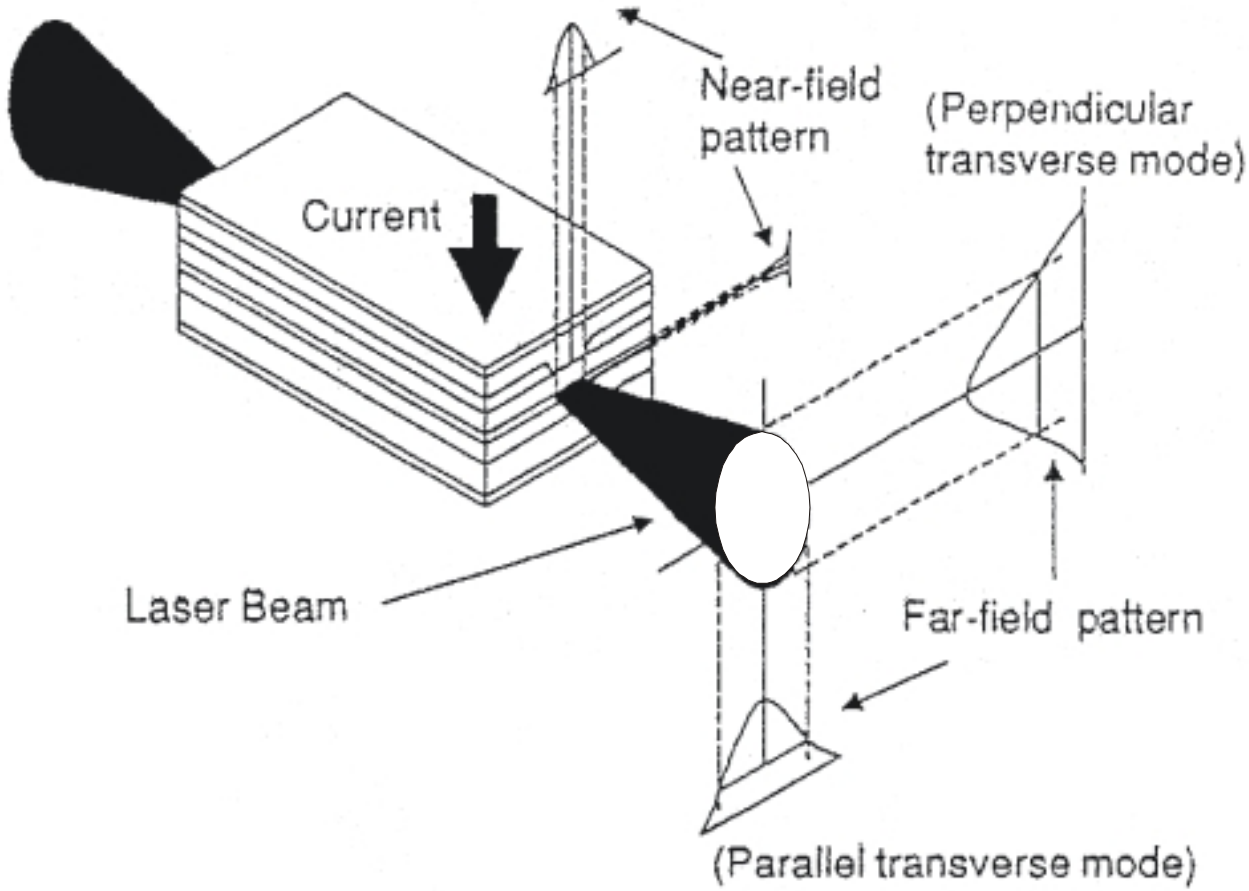
Near-Field Optics (NSOM) Plays A Bridging Role Between Conventional Optical Microscopy And Atomic Force Microscopy

Demonstrating the uses of near-field optics

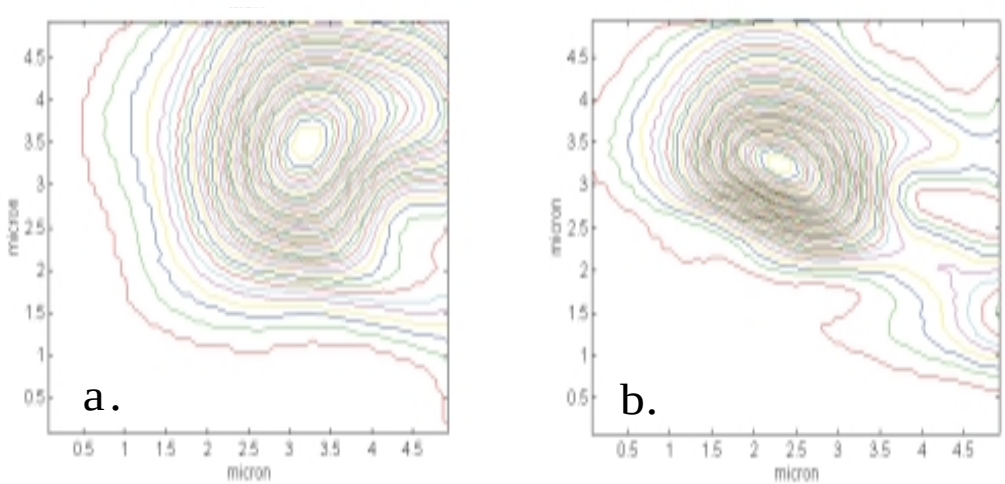
- Slab waveguide lasers
- V-Groove lasers
  - Correlating structure with light emission
  - Correlating mode structure with wavelength
  - Correlating mode structure with heat

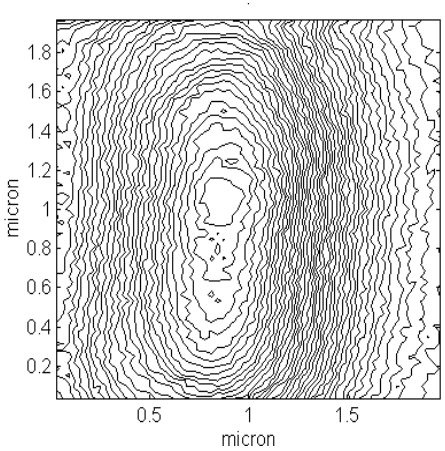
- Optical waveguides
  - Optical fiber mode distribution with alterations in coupling
  - Polarization dependence of evanescent fields
  - Imaging the Tien effect
  - Imaging star couplers

Light distribution analysis with 0.05 micron spatial resolution of slab waveguide lasers emitting at 1.5 microns

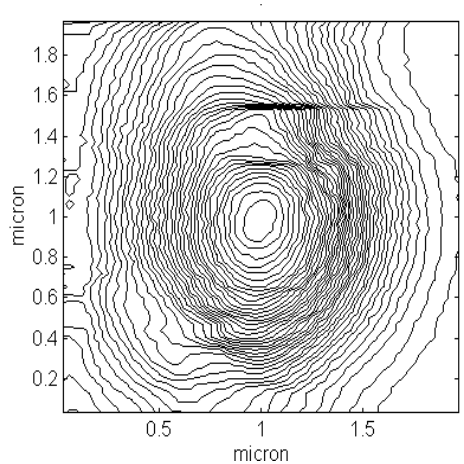


A comparison of the (a) far-field and (b) near-field light distribution

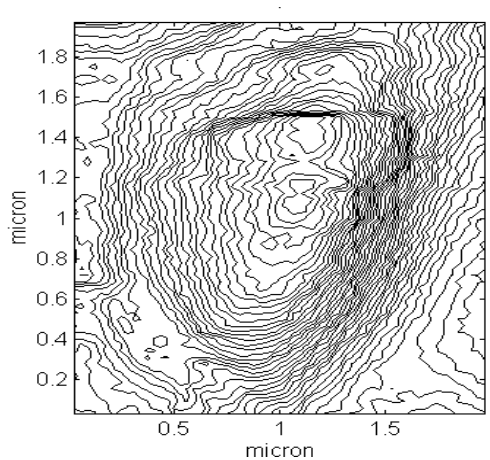




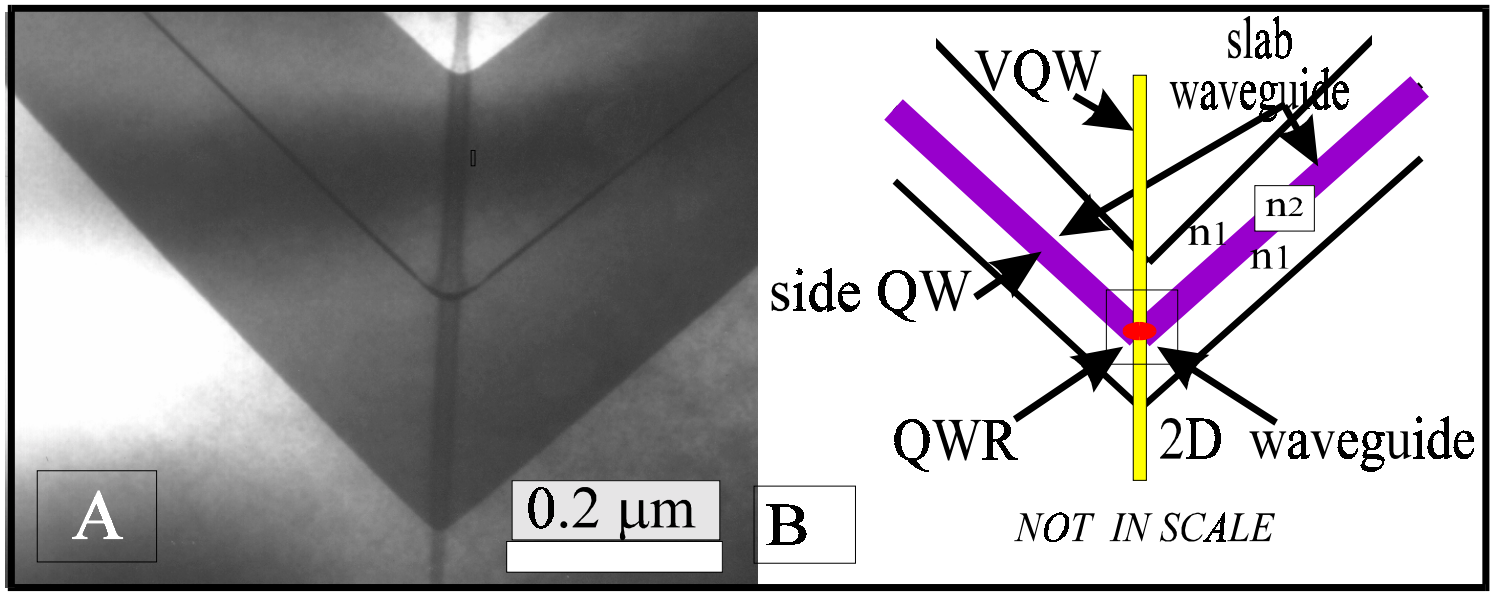
NSOM Light Distribution From The Laser Cavity With An Injected Current That Is Below The Threshold For Lasing Action



NSOM Light Distribution From The Laser Cavity With An Injected Current That Is Above The Threshold For Lasing Action

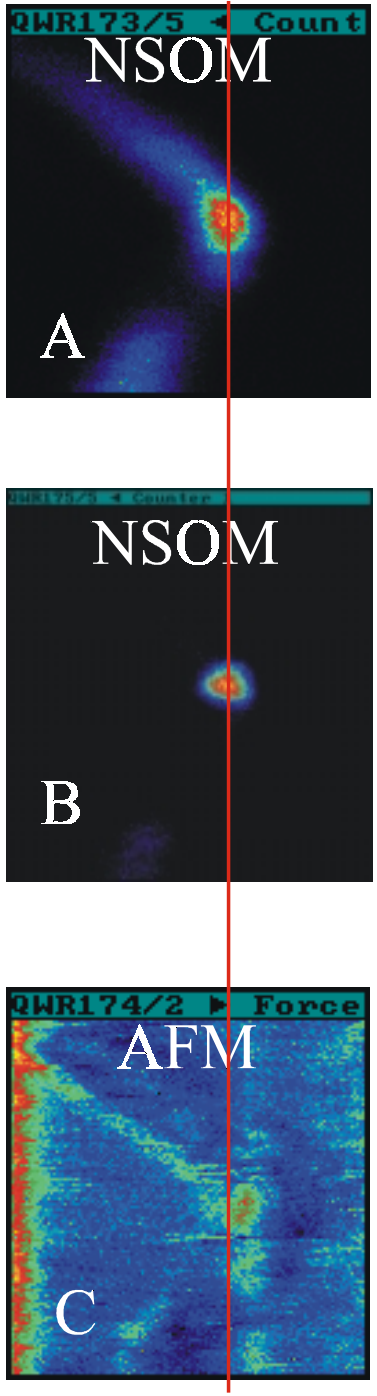


Injected Charge Distribution Measured Using the Simultaneous Atomic Force Capabilities With an Injected Current Above the Threshold for Lasing Action



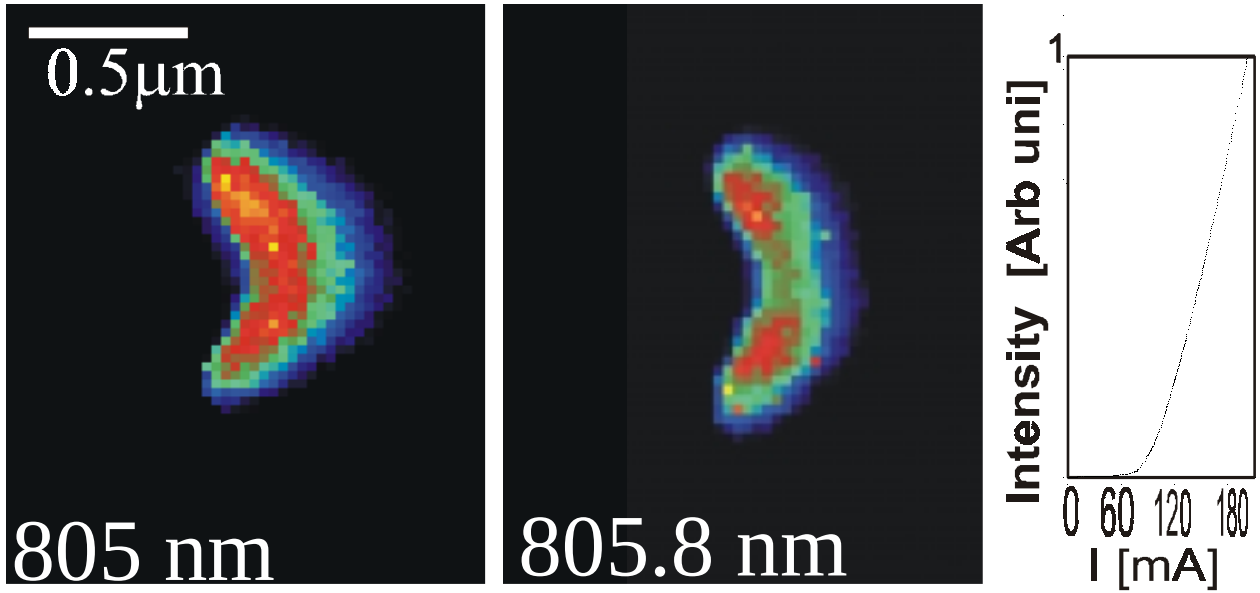
An Electron Micrograph Of The V Groove Laser Structure

Diagrammatic Representation Of The Structure (B).



1. Correlation of the light distribution and geometric structure of the v groove laser

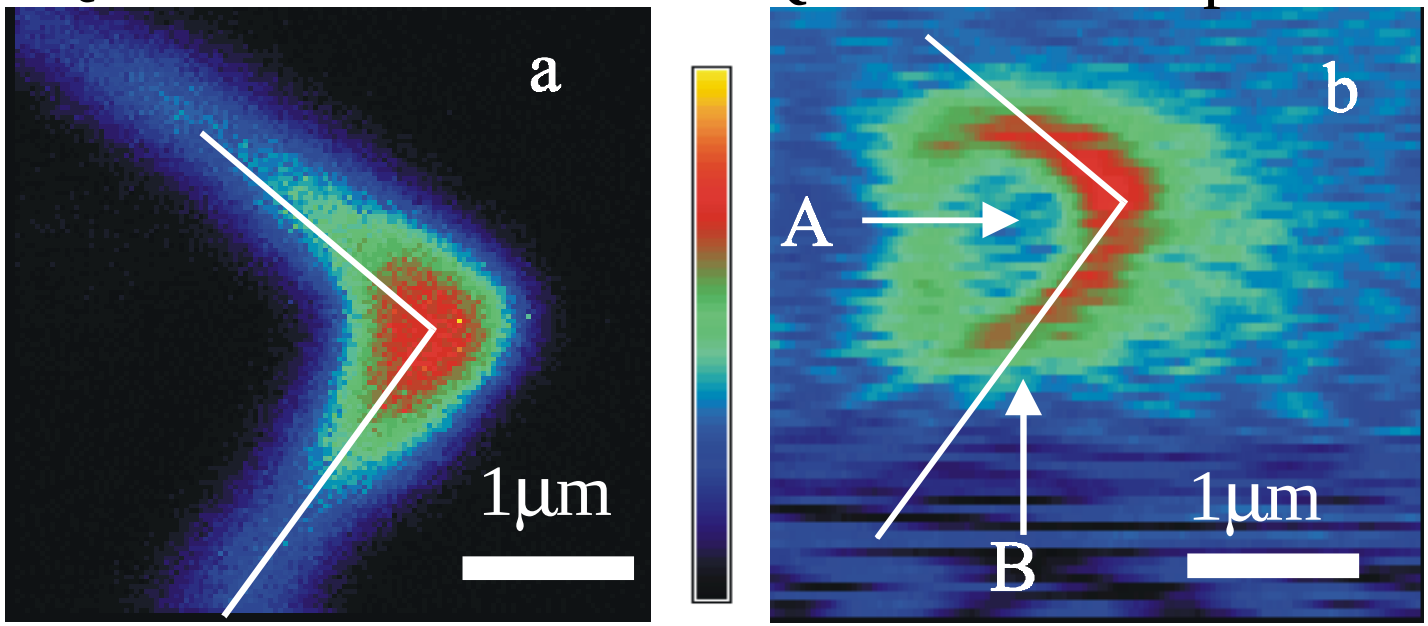
2. Notice the 150 nm offset



Correlation of mode structure with wavelength alteration

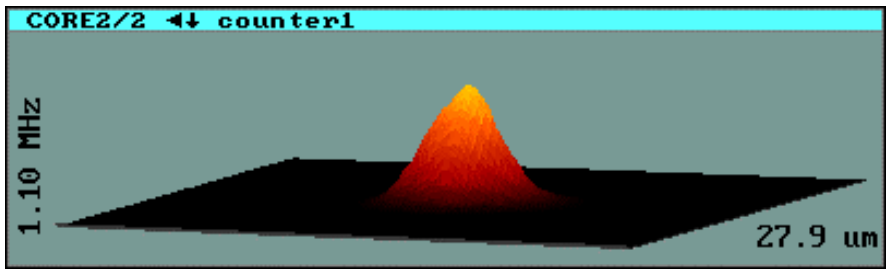
QWR293 -NSOM

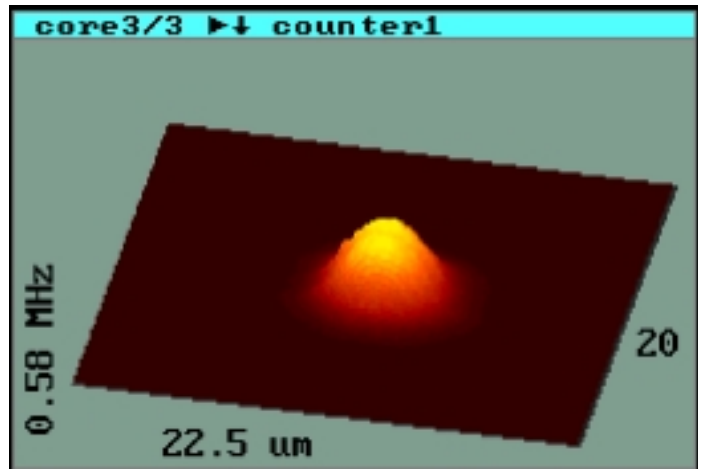
QWR294 -Temperature

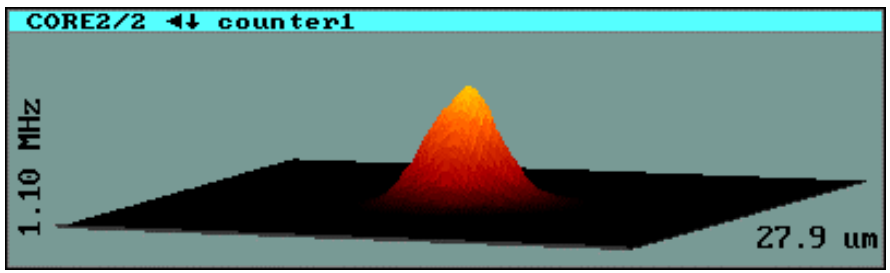


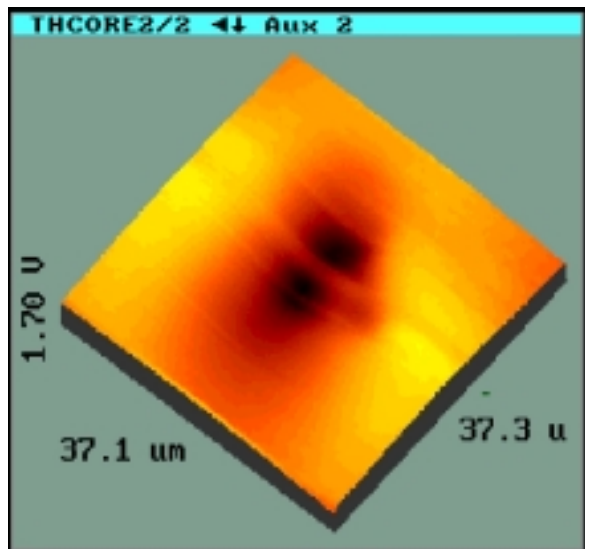
Correlation of light distribution with thermal characteristics

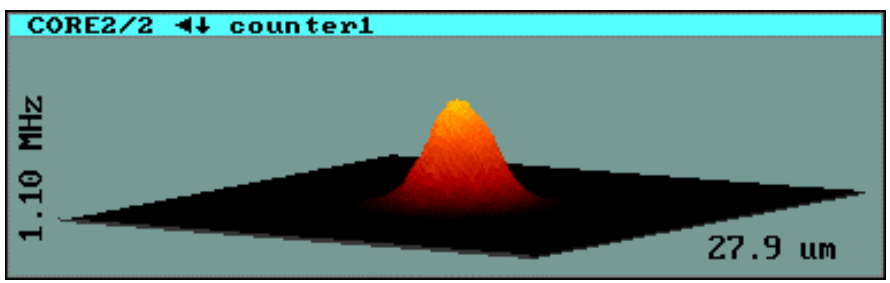
Optical Fiber Output Analysis



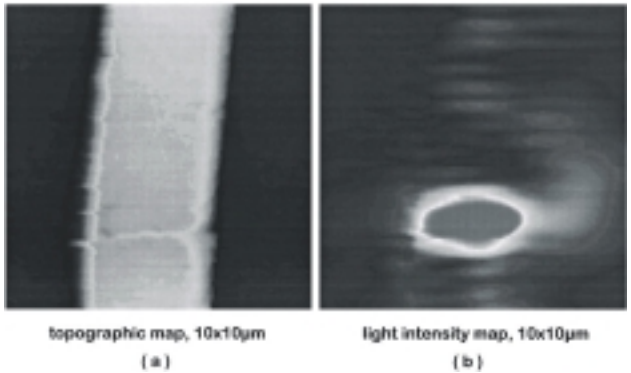




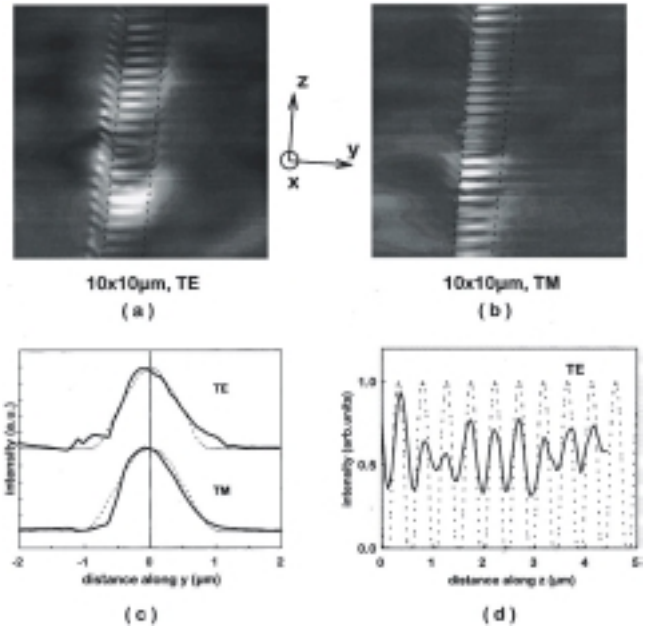




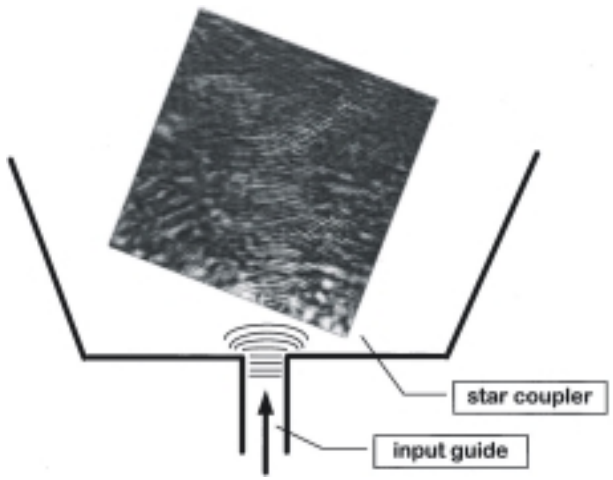
Correlation of light distribution with fiber coupling



Images taken from Applied Physics Letters Vol. 73, 1035-1037 (1998)



10 nm deep topographic alteration correlated with light leakage from a waveguide that corresponds to an ~ 0.05 dB guided power loss



Near-field optical image of the star coupler section of a phasar device

Near-field optical images of the evanescent field for TE and TM polarization of a semiconductor waveguide

Summary

Near-field Optics

exceptional integrated information on today's components
with a resolution and an information content critical
for components in sight for tomorrow
and
being considered for tomorrow

[S. Shanhui, I. Appelbaum & J. D. Joannopoulos, "Near-field scanning optical microscopy as a simultaneous probe of fields and band structure of photonic crystals," Applied Physics Letters **75**, 3461 (1999)]

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